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IDENTIFICATION OF PHENOLOGICAL STAGES AND VEGETATIVE TYPES FOR LAND USE CLASSIFICATION

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July 31, 1973

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One of 12 ERTS-1 projects conducted by the University of Alaska
ERTS-1 project, GSFC No. 110-2
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16. Abstract
Objectives of Project 110-2 are to determine methods of processing ERTS-1 data products to determine vegetative associations and land forms and to relate these data to recommendations for land use. Specific responsibility for the Southern part of the 100 nautical mile transect at the 150 W meridian has been assigned to Project 110-2.

During this reporting period ERTS-1 data from the Kenai Peninsula and Matanuska-Susitna Valley areas were studied. From 70 mm chips and black and white prints, two 1:250 K vegetation maps were constructed from ERTS MSS scenes 1049-20505 and 1066-20453. Total land areas mapped were approximately 1,000,000 acres and 2,500,000 acres respectively. Digital data were used to construct a vegetation map of 464,000 acres in the Matanuska-Susitna Valleys. Areal extents of each vegetation type identified were also extracted from those data. The map from the digital data is the only available vegetation map of the area showing detailed distributions of birch and spruce. We substantially reduced our ERTS program efforts since April to save funds for automated data processing with the CDU and Zoom Transfer Scope.

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I - INTRODUCTION

A: Scope and Purpose of Report

This report summarizes work performed and conclusions reached during the second six months of Contract No. NAS5-21833 ERTS-1 Project No. 110-02, "Identification of Phenological Stages and Vegetative Types for Land Use Classification."

B: Summary of Work Accomplished to Date

We have received a partial shipment of over 200 ERTS scenes acquired during 1973. These have been evaluated for quality, indexed and filed. Over 500 oblique 35 mm slides were taken from low flying aircraft for ground truth support. These too have been indexed and filed for expedient retrieval.

From 70 mm chips and black and white prints, two 1:250 K vegetation maps were constructed from ERTS MSS scenes 1049-20505 and 1066-20453. Total land areas mapped were approximately 1,000,000 acres and 2,500,000 acres respectively. Digital data were used to construct a vegetation map of 464,000 acres in the Matanuska-Susitna Valleys. Areal extents of each vegetation type identified were also extracted from those data. The map from the digital data is the only available vegetation map of the area showing detailed distributions of birch and spruce.

We reduced substantially our ERTS program efforts since April to save funds for automated data processing with the CDU and Zoom Transfer Scope.

II - STATUS OF PROJECT

A: Objectives

The overall objective of the project is to locate and classify potential agricultural lands in an area subject to high developmental pressures. The scarcity of agricultural land in Alaska re-emphasizes the need to develop sound criteria for land use planning. Lands having agricultural potential must be identified within the framework of a long range planning structure, if agriculture is to survive and prosper in Alaska.

Our immediate objective during the reporting period has been to recognize and delineate vegetative types from ERTS data. Once major vegetative types are determined, the agricultural potential of those lands can be estimated from what is known about the vegetative associations, and their respective drainage patterns and soil types.

B: Accomplishments During the Reporting Period

1. Preliminary Investigations

Three printouts of digital MSS data have been received from the U of A computer center for scene 1049-20505. We are pleased with our progress on identifying MSS signatures of vegetation, particularly for spruce, birch and grass. Areal extents of these types were also computed from digital data for the Matanuska-Susitna test area.

We have been unable to separate muskeg from browse, two dominant vegetative types in the test area. Early spring (prior to leafing out of the deciduous trees) is suspected as being the best time for mapping Alaskan vegetation from MSS data due to the radiometrically distinctness of the vegetation communities at that time. However, in 1972 the satellite was not orbiting during that period, and in 1973 storm systems moved across our test areas during the two early spring sampling periods. Had data been collected during this period, quite possibly separation of these vegetative types would have been possible.

A back-lighted projection table was constructed for drawing vegetation overlay maps at 1:250 K from projected 70 mm MSS chips. Vegetation maps 1:250 K scale were hand drawn from projections of 70 mm MSS chips for the Matanuska-Susitna Valleys, and Kenai Peninsula from ERTS scenes 1033-21020, 1049-20505, 1049-20512 and 1066-20453. These maps show vegetation distribution but, are very general compared to the details contained in our digital data maps.

Vegetative overlays mapped by Lloyd A. Spetzman and assembled by the joint Federal-State Land Use Planning Commission have been obtained for ten different 1:250 K quadrangle maps. The base for this compilation of data is 1:40,000 aerial photography flown by the military.

The vegetative overlays derived from 70 mm MSS chips compare favorably with Spetzman's work. ERTS can provide an accuracy check with the Spetzman vegetative information and in cases where the original mapping is rough, possibly provide greater accuracy. We also obtained vegetative overlays for two 15 minute quadrangles with which to compare digital data.

Ground truth was collected along the west side of Cook Inlet, the Matanuska Valley and the Kenai Peninsula during travel on other projects. These data have proven valuable for interpreting ERTS-1 imagery.

ERTS-1 data are being used in locating potential grazing lands on the Kenai in connection with the University of Alaska's red meat research program. One rather extensive, although presently inaccessible, grassland was discovered on scene 1066-20453.

The University has leased considerable land holdings on the Kenai for the purpose of developing a Beef Research Experimental Station. Over 6,000 acres have recently been mapped in considerable detail for planning purposes relative to the branch station. Trying to utilize this sizeable area of intensive ground truth we requested a magnetic tape for scene 1066-20453. Recently Project 1 did a computer analysis of the scene so marked and discovered from the printout of the computer that the tape actually was for scene 1153-15244, located in some other part of the world. We still await a reordered tape.

A partial shipment of over 200 scenes for 1973 has been received. These have been evaluated for quality, indexed, and filed. We also received approximately 80 color and color infrared aerial prints flown by mission 209 for flight lines 4 & 5, located in the Matanuska-Susitna Valley areas of Southcentral Alaska.

Prints (8" x 10") of color additive viewer displays were ordered and received. These proved useful for mapping vegetation features; however, in many instances black and white data were either equal to or better than the color products for identifying boundaries of tonal differences.

An agreement was finalized with the Federal-State Land Use Planning Commission. They are supplying 50% of the funds required to purchase a Zoom Transfer Scope. The balance of the purchase price is being supplied from other Institute of Agricultural Sciences projects. The Land Use Planning Commission and those IAS projects will receive information from ERTS data and/or use of the Zoom Transfer Scope in return for their financial contributions to the ERTS program.

While on other business, Dr. McKendrick visited with ERTS investigators from Lockheed Electronics, Oregon State University, the University of Idaho, Kansas State University and Kansas University in order to compare ERTS data processing techniques and to become more familiar with the overall program. In addition he attended the remote sensing session of the 26th annual meeting of the Society for Range Management. While in Lawrence, Kansas, he acquired firsthand experience with the CDU under construction by Interpretations Systems Incorporated and their VP-8 image analyzer. With the latter instrument he obtained 75 color slides of density sliced displays from the 1049-20505 scene.

We have met with Project 3 personnel several times, traded data analyzing progress reports and agreed to the need for a uniform vegetation classification scheme between Projects 2 and 3. The agreement insures that the two groups will use identical terminology and vegetative classifications so that vegetative types from different sections of Alaska can be compared and correlated with other environmental information such as soil, ground water, and climatic data.

2. Applicability of ERTS-1 data to project objectives

The success of Project 110-2 depends on our ability to locate and classify dominant vegetative types using ERTS data. Initial analysis was based primarily on the capabilities of the color additive viewer. Several 3M color key sandwiches were processed by Project 1's photo lab. Viewings from the color additive viewer and 3M color key process is very helpful in delineating major vegetative types but color enhanced photographic analysis often lacks required precision to identify specific vegetative types from ground resource information.

A back-lighted projection table was constructed and 70 mm MSS ERTS clips projected. Vegetation overlays have been hand drawn for the Matanuska-Susitna Valleys and western Kenai Peninsula by utilizing ERTS scenes 1049-20505, 1066-20453, 1033-21020, and 1049-20512. Those vegetative overlays provide good general information but we have derived significantly more detail through automated processing techniques by producing digital data maps. The digital data of the Matanuska Valley provides the only available vegetation map that shows distributions of birch and spruce in the area. Analysis of ERTS scenes strongly depends on supporting aircraft and ground truth data. We have found that oblique photographs taken from low flying aircraft, provide excellent ground information when used in conjunction with aircraft data.

It is not practical to consider using ERTS data for phenological studies in Alaska. The phenological changes occur far too fast in the northern latitudes to be monitored by ERTS. Our experience has been that not more than one or two useable scenes are obtained for a specific area during the growing season in Southcentral Alaska.

Several potential ERTS-1 user agencies have been contacted regarding making ERTS operational and we asked them to help acquire cost benefit figures. Those agencies include: Forestry Research and Inventory, Keith Hutchison, Juneau; State Division of Natural Resources, William A. Sachek, Anchorage; Bureau of Land Management, Tom Hazard, Anchorage; Soil Conservation Service, Weymouth E. Long, Anchorage; joint Federal-State Land Use Planning Commission, John Hall, Anchorage.

3. Results

A large grassland was located on the Kenai Peninsula which may be a potential grazing land. Two 1:250 K vegetation maps were constructed from ERTS scenes 1049-20505 and 1066-20453 using 70 mm MSS chips and black and white prints for an area of 3.5 $\overline{M}$ acres. Another area (464,000 acres) was mapped using digital data. The latter map is the most accurate and detailed vegetation map of that area produced to date. Areal extents of identified vegetation types were derived for the area mapped from digital data.

Physical features which we have delineated on digital data include: silty water, clear water, clouds, shadows, spruce, birch and grassland. Considerable overlap of signatures occur between muskeg and browse, two dominant vegetative types within the test area. It is not possible to delineate those features during the time our data was collected.

During late April and early May, the colors of natural vegetation in Alaska are most distinct. For example: birch are reddening, Populus spp. are grey, the grasses are yellow-brown and the spruce are green. In that season we are able to easily identify the various vegetation communities from low flying aircraft and on aerial color photos. If cloud-free ERTS data were collected during this period it is quite likely separation of these and other vegetative communities would be possible. Vegetative overlays produced at a scale of 1:250 K compare favorably with 1:250 K vegetative maps assembled by the joint Federal-State Land Use Planning Commission. Lloyd A. Spetzman spent years mapping Alaska vegetation for the military. ERTS can now provide an accuracy check for Spetzman's vegetative information and in cases where original mapping is rough, possibly provide more detail.

III - NEW TECHNOLOGY

None

IV - PLANS FOR NEXT REPORTING PERIOD

A request for contract extension to January 30, 1974 with no increase in NASA funding was submitted and approved in order to give us access to a full year's data (all seasons) and an opportunity to use automated data processing with the CDU. We will continue using conventional mapping techniques on the 9 1/2" prints and 70 mm chips.

Digital data will be analyzed to identify signatures and produce printouts on scenes 1103-20503, 1066-20453. We expect to use the CDU and VP-8 image analyzer for testing signature validity and mapping (scenes 1049-20505, 1049-20515, 1066-20453, and 1033-21020), if the unit becomes available. The Zoom Transfer Scope is expected to be a powerful tool for testing signature validities, locating plant community boundaries and mapping vegetation from digital and image data.

Ground truth information will be collected for the upper Susitna Valley area.

V - CONCLUSIONS

A great amount of detail can be delineated by automated processing techniques--for instance, silty water is differentiated from clear lakes and shallow water from deeper water. Delineation of certain vegetative types is possible. We have plotted narrow bands of birch-aspen stands and separated birch, spruce, and grassland types in scene 1049-20505.

Furthermore, the computer printouts provide an accurate means for calculating areas of designated features. Vegetation maps produced at 1:250 K from 70 mm ERTS projections show major vegetation distribution patterns but are very general compared to details found in digital data.

The work conducted so far indicates that the color additive means of analysis requires supplemental support by digital methods to gain specific information at any one location. By comparing digitally listed areas to CAV projections, vegetative types can be extrapolated by photographic analysis.

Analysis of ERTS data strongly depends on supporting aircraft and ground truth data. It is not practical to monitor phenological changes in South-central Alaska using ERTS data; phenological changes occur much too rapidly. Cloud-free weather did not coincide with the satellite orbit during the greening period of 1973.

VI - RECOMMENDATIONS

Data collections for vegetation mapping are needed in the early spring in Alaska when vegetation types are radiometrically most distinct. Since weather uncertainties create problems in early spring, possibly a manned platform that could be directed to collect data when conditions are best (i.e. Skylab) could overcome the cloud interference problem. Extremely accurate vegetation maps of Alaska could be constructed from ERTS data collected during that season of the year compared to either winter or summer seasons when vegetation types are radiometrically less distinct.

We are hopeful that the VP-8 image analyzer and CDU soon become operational. We should also receive the Zoom Transfer Scope in the near future. This equipment will significantly increase our ability to determine vegetative types from both automated processing and visual analysis methods.

We recommend obtaining either stereo or single frame oblique photographs from low flying aircraft when acquiring ground truth data. A large amount of data can be collected for an extensive area in a short period of time.

VII - PUBLICATIONS

None

VIII - REFERENCES

None

IX - APPENDICES

Appendix A: Changes in Standing Order Forms: None

Appendix B: ERTS Data Request Forms:

7/18/73 Bulk digital 9-track computer compatible tapes for scenes 1300-20460, 1103-20513, and 1104-20572

Appendix C: ERTS Image Descriptors Forms: Completed forms from new data received are attached.

APPENDIX C

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D
N
ID

DATE July 31, 1973

PRINCIPAL INVESTIGATOR Jay D. McKendrick

GSFC UN-641

ORGANIZATION University of Alaska 110-02

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*				DESCRIPTORS
	River	Glacier	Lake	Mts.	
1267-21030	✓	✓	✓	✓	Glaciers
1283-20513	✓	✓	✓	✓	Glaciers
1283-20520	✓		✓		Inlet
1283-20511	✓	✓		✓	Basin
1266-20581	✓		✓	✓	
1280-20335	✓		✓	✓	River
1280-20342	✓		✓	✓	
1266-20572	✓	✓	✓	✓	Valley
1284-20580	✓			✓	Peninsula
1284-20574	✓	✓	✓	✓	River
1300-20463			✓	✓	Peninsula
1300-20460	✓	✓	✓	✓	Valley
1247-20511	✓	✓	✓	✓	City

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

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APPENDIX D: Significant Results

Second Semi-Annual Progress Report
University of Alaska
ERTS Project No. 110-02
July 31, 1973

PRINCIPAL INVESTIGATOR: Jay D. McKendrick

TITLE OF INVESTIGATION: Identification of Phenological Stages and Vegetative Types for Land Use Classification

DISCIPLINE: Agriculture/Forestry/Range Resources

SUBDISCIPLINE: Range Survey and Classification

SUMMARY OF SIGNIFICANT RESULTS:

A large grassland was located on the Kenai Peninsula which may be a potential grazing land. Two 1:250 K vegetation maps were constructed from ERTS scenes 1049-20505 and 1066-20453 using 70 mm MSS chips and black and white prints for an area of 3.5 $\overline{M}$ acres. Another area (464,000 acres) was mapped using digital data. The latter map is the most accurate and detailed vegetation map of that area produced to date. Areal extents of identified vegetation types were derived for the area mapped from digital data. Early spring (prior to leafing out of the deciduous trees) is suspected as being the best time for mapping Alaskan vegetation from MSS data due to the radiometrically distinctness of the vegetation communities at that time.

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